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ABSTRACT

During the 1969-70 academic year the author engaged in an extensive program of research training at the Bell Telephone Laboratories. He studied multidimensional scaling techniques and used many of these techniques in the analysis of data resulting from experiments and studies of the visual and cognitive perception of letters and words. The objectives were to increase competence in understanding and applying multidimensional scaling techniques with particular emphasis on their use in solving problems of motivation and perception in the typical educational environment, in studying values about education, and in teaching others the most effective scaling techniques. Long program was essentially an internship involving many individual seminars. Long term results will be measured by the kind and quality of research produced in the future. New scaling techniques are already being used in various projects at the University of Hawaii, and dissemination seminars are being scheduled. (MEM)

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Postdoctoral Fellowship Program in Educational Research

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Summary

During the 1969-70 school year Dr. Peter Dunn-Rankin engaged in an extensive program of research training at the Bell Telephone Laboratories under the guidance of Dr. Joseph Kruskal. Dr. Dunn-Rankin studied multidimensional scaling techniques and used many of the techniques in the analysis of data resulting from experiments and studies of the visual and cognitive perception of letters and words.

Introduction

The objectives of the postdoctoral fellowship were to increase the competence of Dr. Dunn-Rankin in understanding and applying multidimensional scaling techniques. His particular interest was in their use in the solutions of problems of motivation and perception within the context of the typical educational environment, in the study of values about education, and in teaching others the most effective scaling techniques.

Methods

The fellowship was essentially an internship under the guidance of Dr. J. B. Kruskal at the Bell Telephone Laboratories. The internship consisted of a great many individual seminars (approximately two a week) with Dr. Kruskal as well as frequent and close consultation with other knowledgeable people at the Bell Laboratories. These included Douglas Carroll, Myron Wish, J. J. Chang, Sol Sternberg, P. A. Kolers at Holmdel, George Sperling, John Krauskopf, Ernest Rothkopf, Larry Frase, C. L. Mallows, Steve Johnson, Paul Tukey, H. O. Pollack, and Esther Coke.

An initial task of empirically analyzing the effectiveness of different parameters used in D. Carroll's Paramap program refurbished programming skills and allowed the subject to gain familiarity with Bell Labs' G. E. 635 Computer. Individual seminars with J. B. Kruskal introduced the Fellow to the solutions of problems using the remote console and the Basic Fortran languages.

The following specific efforts were made during the training periods: (1) Extensive reading of the Bell Labs' memorandums, books, and articles relating to scaling, statistics, psychometrics, and perceptual learning; (2) attendance at Visiting Professors' seminars in mathematics, statistics, psychometrics, and perceptual psychology; (3) reanalysis of existing data on visual word preference and the revision of several papers; (4) design and construction of a device to measure visual response latencies; (5) exploration of (a) new ways to hierarchically cluster objects and (b) new solutions for initial configurations to existing multidimensional scaling programs; (6) designing and implementing experiments in the perception of letters and collaborative analysis of resulting data with J. B. Kruskal; and (7) attending seminars in statistics and psychometrics outside of the Murray Hill area.

Results

Long term results will only be measured by the kind and quality of research produced in the future and in the production of research by students of the Fellow.

Specific results over the 10-month study include the following:

Projects

1. Analysis of Individual Differences in the Perception of Reading Units. (Designed and built the equipment to measure response latencies; designed, ran, and analyzed the results of three separate experiments.)

2. Identifying Individual Value Patterns. (Design of study was undertaken.)

3. Hierarchical Triangular Clustering. (A new approach to grouping was concluded. A paper on the method will be read at the AERA Annual Meetings in 1971.)

4. Triangular Mapping. (A basic preliminary approach to scaling has been established and a computer program written. Preliminary results are encouraging. This study awaits the further refinement of sequential analysis.)

5. The analysis of parameters which are most effective for Paramap. (An empirical analysis of the parameters of Douglas Carroll's continuity function was undertaken. Results were summarized.)

6. The Three Dimensional Analysis of Error-Word Preference. (A separate analysis of Error-Word Preference Data was undertaken utilizing the G. E. 635 to construct 3-D pictures of the factor matrix. A paper will be read at the AERA Annual Meetings in 1971.)

Computer Programs Written

1. Hierarchical Triangular Clustering

2. Program to Generate N Regular and Random Points on the Surface of a Sphere

3. Triangular Mapping

4. Program to Generate N Random Points in a Two-Dimensional Space and Plot the Data

5. A Program to Generate and Punch all the Contrast Pairs for N Objects.

6. A Revision of Paramap (A computer program by J. J. Chang and D. Carroll for scaling data using continuity as a base).

(In addition approximately 10 other small programs to revise subroutines or to change and display data were written.)

Collection and Debugging of Computer Programs to Augment EDRAD Library

MDSCAL (Version V)	Multidimensional Scaling, J. Kruskal
INDSCAL	Individual Differences Scaling, D. Carroll
LPA	Latent Partition Analysis, B. Pruszek
HICLUS	Hierarchical Clustering, S. Johnson
PREFMAP	Preference Mapping, D. Carroll
PARAMAP	Parametric Mapping, D. Carroll
MDPREF	Multidimensional Preference, C. Carroll

Papers Written

1. Hierarchical Triangular Clustering

2. A Critical Analysis of Sesame Street (mimeo)

3. Analyzing the Development of Reading Skill Using an Error-Word Preference Inventory (mimeo)

4. Monte Carlo Distributions of the Range of Rank Sums in the One-Way Classification

Miscellaneous

1. Activity--AERA, Minneapolis, Chaired "Research in Reading I" and Panelist "Criterion Measures--Bane or Boon"

2. Advanced Study--AERA Presession in multivariate analysis, Chicago, February, 1969

3. ETS invitational conference on testing problems, New York

4. ETS L. Guttman Lectures, Princeton, N. J., 1969

5. Belmont Orientation Conference, Elkridge, Maryland

6. Seminar with P. A. Kolers, Holmdel, New Jersey

7. Consultation with P. Cartwright on CAI, College Park, Pa.

(In addition attended approximately 20 lectures from visitors to Bell Labs, Murray Hill, including Norman Cliff, L. Guttman, W. Kohler, etc.)

Conclusion

The postdoctoral fellowship will have a continuing impact on the research done in educational psychology at the University of Hawaii. Already new scaling techniques are being utilized in various projects. Specifically, the use of individual differences scaling provide a major new instrument in the analysis of reading skills. Dissemination seminars are being scheduled at the University.

While the Bell Labs is not essentially a training institution, the expertise available allowed for a unique instructional experience. Almost every lunch-time discussion or private consultation amounted to a private seminar with an expert in his particular field. This was a unique feature of my fellowship and I would encourage more effort for fellows to become affiliated with private industry in the future as long as its personnel can be of the calibre displayed at Murray Hill.